Resonant field patterns in negative magnetic metamaterials

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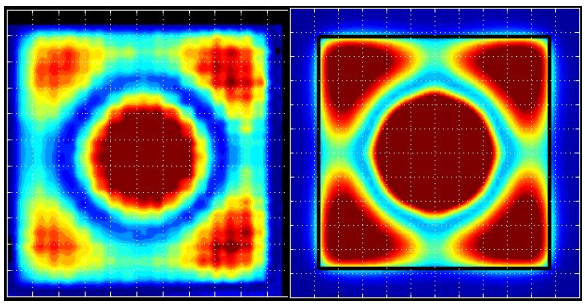
The “Swiss Roll” structure is an anisotropic magnetic metamaterial that has proved very suitable for the radio frequency (RF) regime. Treated as an effective medium, the permeability along the axis has a resonant form and exhibits negative values over a significant bandwidth (up to 40% has been achieved). When a prism of such material is excited by an RF magnetic field, it exhibits a complicated sequence of resonances. In this work, we examine whether an effective medium model can describe this behaviour.

The field distribution was measured by scanning a small loop detector above the surface of a square prism of Swiss Rolls, excited by a similar loop below the slab. Modeling was performed using MicroWave Studio, with permeability parameters derived from those measured for the material. Excellent agreement (see figure) over most of the negative permeability range was obtained.



Measured (left) and calculated (right) magnetic field distributions at 24.9MHz